There do not at present appear to be any considerations, either of theory or fact, which would limit the applicability of these laws to the comparatively narrow field to which the term photoelectric effect is usually restricted. For instance, there is no apparent reason why they should not be applicable to the ionization produced by such radiations as the Röntgen and γ rays. Moreover the deduction makes no essential use of the fact that the particles have been supposed to be electrically charged; so that similar laws may be expected to characterize the reversible formation of gaseous chemical products under the influence of ætherial radiations.

There is one other point. Equations (1)–(6) have been derived without making use of the hypothesis that free radiant energy exists in the form of "Licht-quanten," unless this hypothesis implicitly underlies the assumptions: (*A*) that Planck's radiation formula is true, (*B*) that, *ceteris paribus,* the number of electrons emitted is proportional to the intensity of monochromatic radiation. Planck[2] has recently shown that the unitary view of the structure of light is not necessary to account for (*A*) and it has not yet been shown to be necessary to account for (*B*). It appears therefore that the confirmation of equations (3), (5) and (6) by experiment does not necessarily involve the acceptance of the unitary theory of light.

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THE CAPE LOBSTER

In noticing the peculiar history of the animal from the Cape of Good Hope, designated under this head, I wish both to correct an error, and at the same time to direct attention to a little known individuality among the higher crustacea.

In a review of Dr. Calman's volume, "The Life of the Crustacea,"[1] this much abused animal was thus referred to:

> We thought that this somewhat shadowy species had never recovered from the aspersions cast upon it by Professor Huxley.

Dr. Calman has kindly called my attention to the fact that the species is really a very substantial shadow, that its nebulous reputation disappeared some years ago, and that Huxley's remarks were not wholly justified in 1878, for the elder Milne Edwards had published a good figure of the animal as early as 1851. Indeed, as we shall see, his still earlier description was based upon an actual specimen.

In my first extended report upon the American lobster[2] the little Cape species was thus referred to:

> A third form, *H. capensis,* has been imperfectly described from the Cape of Good Hope, but it is doubtful if it belongs in this genus.

Such doubt as then existed has since been cleared up, and the species should have been included in my recent work on "The Natural History of the American Lobster."[3]

The facts regarding the literary history of this neglected species are briefly as follows: It was first figured and described by Herbst under the name of "The Cape Crayfish," *Cancer* (*Astacus*) *capensis,* in 1796,[4] and in a way to puzzle all future students who placed any confidence in his statements. Under the head of "The Cape Crayfish" was this brief description: "Museum Spengler. *Astacus,* slender, with smooth thorax; claws (manus), hairy, with crenate border; all the legs chelate"; followed by this even more vague and contradictory account:

> This beautiful crab (Krebs) occurs at the Cape in mountain streams. It is similar indeed to our common crayfish, but is more slender, and of equal

[1] See Science, N. S., Vol. XXXV., No. 892, February 2, 1912.

[2] *Ber. der. Deutsch. Physik. Ges.,* 1912.

[2] "The American Lobster: A Study of its Habits and Development," Bulletin of U. S. Fish Commission for 1895, p. 8.

[3] Bulletin of the Bureau of Fisheries, Vol. XXIX., Document No. 747, issued July 13, 1911.

[4] Johann Friedrich Wilhelm Herbst, "Versuch einer Naturgeschichte der Krabben u. Krebse, nebst einer systematischen Beschreibung Arten. B. 2, Krebse," Tab. XXVI., Fig. 1, and p. 49. Berlin u. Stralsund, 1796.

breadth throughout. It is coral red in color and has a beautiful sheen resembling the carnelian. Whether this is its natural color, or whether it is due to cooking, I can not decide. The appendages are relatively small. The base of the hand (carpus or fifth segment) nearly surpasses the arm (meros or fourth segment), and is strongly tuberculated; the hands are large, and are bordered, moreover, with a very delicately raised and toothed margin (Rande), studded everywhere with yellowish, transparent hairs. The feet are all chelate, while in the common crayfish the first pair only have this character.

This faulty description seems to have been drawn from an imperfect specimen, or with insufficient care, supplemented by incorrect data in regard to habit, and not very happy guesses in filling up the gaps of whatever sort.

Herbst's work was in a large measure a compilation, being at the same time a curious and interesting epitome of the life and lore of the Crustacea from the most ancient times. The numerous drawings which were in copperplate and colored by hand, are rather poor even for the period (particularly in this volume), when not copied from a master, like Roesel von Rosenhof. Any statements regarding the problematical Cape species need not have been taken too seriously, when of the common European lobster which had been known and eaten from antiquity, he stated in the same paragraph, that it carried its eggs under its tail, and laid them in the sand.[5]

As an illustration of another side of Herbst's work I give the following in free translation:

Crayfish, when kept in confinement are fed with beer daily, or with sweet milk, which is better, and of which they are very fond.

[5] "The pairing season (of the European lobster) begins in spring, and continues during most of the summer. Their fertility is uncommonly great; *12,444 eggs have been counted under the tail of a single lobster,* not to speak of those which still remained in the body. *They lay their eggs in the sand, where they are hatched by the sun.*" Italics mark this contradiction, which is the more singular from the fact that Roesel's figure of the crayfish's eggs attached to the swimmeret is reproduced. The last statement was probably copied from Pennant.

It is in this work also that we have a figure of the Pope's head in the lobster's stomach (Tab. 46, fig. 5), for as the writer says:

The middle and lateral teeth (of the gastric mill) give a striking impression, and may be likened to the Pope, seated in the choir with his cardinals (p. 205).

If the legs of Herbst's "Krebs" were all chelate, or if it lived in mountain streams, as Professor Huxley remarked,[6] it could be neither crayfish nor lobster, since in both there are but three pairs of chelate or double claw-bearing legs, and the lobsters were, so far as known, exclusively marine. On the other hand Milne Edwards at an early period rightly showed that Herbst's *Cancer* was a true lobster, and as such briefly described it in his "Natural History,"[7] under the name *Homarus capensis.* His description, now known to be correct, so far as it goes, was as follows:

Body slender; rostrum flattened, much shorter than the peduncles of outer antennæ, and finely toothed along its borders. Carpus granular; hands elongate, greatly compressed, garnished over their upper surface with a finely denticulate crest, and covered with hairs above. Length about 5 inches.

That this description was made from an actual specimen we have the testimony of Milne Edwards himself, who, as Stebbing remarks, placed after it in his "Natural History," the letters "*C. M.,*" which mean "those species which exist in the Museum of Natural History, where they will be found arranged in the same order as in this work." The drawing of the species, which as we have seen was published fifteen years later, excepting the crude figure of Herbst, remains the only one in existence to this day. Unfortunately Milne Edwards's figure appeared in a highly technical paper of a general character,[8] where it

[6] Huxley, T. H., "On the Classification and Distribution of the Crayfishes," *Proceedings of the Zoological Society of London,* pp. 752–788, London, 1878.

[7] "Histoire naturelle des Crustacés," T. 2, p. 335, Paris, 1837.

[8] "Observations sur le Squelette Tégumentaire des Crustacés Décapodes et sur la Morphologie de ces Animaux." Plate 11, fig. 1, *Ann. Sci. Nat. Zoologie,* Sér. 3, Vol. XV., Paris, 1851.

was inevitably overlooked, since this species was used merely as the exponent of the genus, and is referred to but once by name, and that under the description of the plate.[9] Huxley was no doubt familiar with this paper, but had he recognized the drawing, he would have certainly referred to it, and the "hopeless perplexity," to which he confessed "respecting the Crayfish or Lobster which is said to occur at the Cape of Good Hope, *Cancer* (*Astacus*) *capensis* of Herbst," would have been mitigated if not removed.

It is evident from the preceding account that the Cape of Good Hope lobster enjoyed a vague and uncertain literary reputation up to 1902 when it was redescribed by Stebbing[10] who gave the first full and accurate description of this interesting form from specimens furnished by Dr. Gilchrist.

The two specimens, a male and female, described by Stebbings, agree closely with the description of Milne Edwards. The serrated rostrum has no teeth on the lower side, and its apex extends beyond the base of the third segment of the first antenna.

A very interesting fact, but still commonly overlooked, is the periodic arrangement, in series of eight, of the spines of the toothed forceps of the European and American lobsters. Though less striking, the arrangement of the tubercles of the cracker claw is characteristic. So far as can be judged from Stebbings's description, these peculiarities are less marked or altogether wanting in the Cape lobster. Of the larger forceps he says:

> The marginal teeth are few and not bulky, hairs at the base of the thumb partly filling the cavity between it and the finger.

In the smaller claw there are said to be "many minute but unequal teeth, and a long brush of hairs."

In the American lobster the rostrum is serrate with fewer and larger teeth; there is usually a spine on its under side near the apex, which extends considerably beyond the third segment of the first antenna. In specimens from three to four inches long short hairs partially fill the cavity between finger and thumb of the larger claw, while the serial teeth of the toothed forceps are quite concealed by matted tufts of setæ, like round stub-brushes, set in rows. The outer margin of the thumb (propodus) carries at its tip a row of about 14 such brushes, made up often of a hundred or more sensory hairs. Moreover, the "lock" or toothed forceps has a locking device, by means of which the jaws when closed can not be moved laterally or strained either up or down; this is effected by a displaced "lock" spine, overlapping tips, and a reversal in the alignment of the teeth whereby they overlap, and do not interlock.[11] A corresponding reversal is seen in the alignment of the setæ, the denser row being uppermost in the thumb (propodus), and lowermost in the dactyl.

To conclude this account of the Cape lobster I quote from Stebbings:

> The color (so far as known), the small size, the pubescence of the body and claws, and the flattened hands of the front chelipeds, will sufficiently distinguish this neat little South African species, less than four inches long and less than three quarters of an inch broad, from the clumsier lobsters of the north.

At last the Cape lobster thus emerges as a true species, of small size and attractive appearance, and like its more famous relatives in Europe and America, it lives only in salt water. It is sincerely hoped that zoologists will not have to wait another half century for an adequate account of both its habits and development.

As if this form were doomed to confusion, Stebbings persists in using the term *Astacus* for the lobsters, but since the decision of the

[9] Singularly enough in my copy of this paper the last page bearing the name of the lobster is missing, though the description has been supplied in manuscript.

[10] "Marine Investigations in South Africa," Vol. 1, p. 34, Cape Town, 1902. See also Stebbing's "General Catalogue of South African Crustacea," *Annals of the South African Museum*, Vol. VI., p. 378, London, 1910; also Calman's review of the same, in *Nature*, Vol. 86, p. 174, April 6, 1911.

[11] See "Natural History of the American Lobster," p. 261.

International Commission on Nomenclature was rendered in August, 1910, in favor of restricting *Astacus* for the crayfishes and *Homarus* for the lobsters, it is hoped that this needless source of misunderstanding will be eventually removed.

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A PANUM INCUBATOR WITH IMPORTANT MODIFICATIONS

ONE of the most pressing needs of a general bacteriological laboratory is an incubator which possesses compartments of different but constant temperatures. Various types have been constructed and are in use to-day. After a rather extended investigation into the subject of incubators the writer chose the so-called "Panum" model with certain modifications. An admirable description of this incubator, together with certain improvements which it has undergone in the Carlsberg laboratory, is given in Klöcker's "Fermentation Organisms."[1] A brief description seems desirable here, in order to impress upon those who are not familiar with the apparatus its salient characteristics.

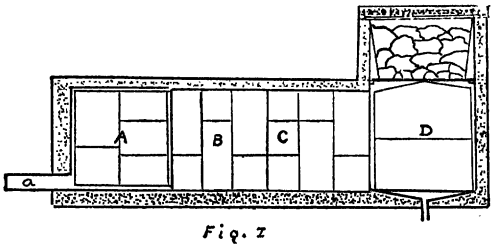

Fig. 1

The incubator consists of three main parts (Fig. 1, *A*, *B–C*, and *D*) which are constructed separately, preferably of thick sheet metal. These three parts are soldered together. The first compartment, *A*, is double-walled. The space between the two walls is filled with water, which is kept at the required temperature by a safety gas lamp which is controlled by a thermo-regulator (*b*). The gas lamp is placed under a projecting wing (*a*) of the outer metal wall. As this wing may burn through in the course of time it is connected with the water jacket by means of screws and flanges which are provided with rubber packing. The projecting wing may be replaced when necessary, without any difficulty. The space between the two walls of *A* is filled with water poured in through holes in the top. The water may be run off through a stopcock situated on the wing.

Compartment *A* is divided into halves by a vertical partition. Division *B–C* is divided into two compartments each of which is subdivided into three equal sections by vertical metal partitions. All of the divisions are provided with two shelves which may be placed at any desired height. The last main compartment, *D*, serves as a refrigerator. It possesses an inner receptacle, the roof of which slopes to the sides and back. This inner box is cooled by water which trickles down over it from ice which is held on a strong grating. The water is run off through an opening in the floor of the main compartment. The ice container is covered with a metal lid over which a thick wooden lid is made to fit closely.

The entire apparatus, with the exception of the front, is covered by a layer of felt 8 centimeters thick and enclosed in a wooden box.

In the words of the book, "Each of the spaces 1 to 8 is provided with a tightly fitting glass door, and doors of sheet iron are fitted on each of the four large compartments, *A*, *B*, *C* and *D*, which are closed tightly by pressing against rubber strips fitted on the partitions. Four corresponding doors, also fitting tightly, are attached to the wooden case, their inner sides being coated with woolen pads. All these doors are hinged below, and when opened and resting in a horizontal position on adjustable brackets may be used as tables."

In the particular incubator under consideration it seemed desirable to make a number of changes or improvements over the model just described. In the first place, heavy copper sheeting was used throughout the apparatus, with the view, of course, of making all the parts more permanent. Besides soldering the three separate divisions

[1] Published by Longmans, Green & Co., London and New York.